NAME (as it appears on your UF ID): _____
(Please **PRINT**)

UF Student ID#: _____

---------- CEN 4072/6070 Software Testing & Verification ----------

Exam 1 -- Spring 2013

You have 90 minutes to work on this exam. It is a "closed-book/closed-notes" test. Pay attention to point values, since you may not have time to work all 15 problems. PRINT your name above NOW and sign the pledge at the bottom of the last page, if appropriate, when you are finished. PLEASE PRINT ANSWERS IN THE SPACE PROVIDED ONLY – PREFERABLY USING A BALLPOINT PEN TO INCREASE LEGIBILITY. Good luck!

1. (4 pts.) Glenford Myers ("The Psychology and Economics of Program Testing") notes that the words project managers use to categorize the results of test cases can be a sign that the wrong definition of testing is being used. Which one of the following best describes what he is specifically referring to? (Circle ONE only.)

   a. He is referring to the tendency of project managers to categorize program testing as "successful" *before* the program has been shown to be error free.

   b. He is referring to categorizing the result of a test case that **did** find an error as "invalid and unexpected" and categorizing the result of a test case that **did not** find an error as "valid and expected".

   c. He is referring to the tendency of project managers to categorize test results as being either **"functional"** in nature or **"structural"** in nature.

   d. He is referring to the tendency of project managers to categorize the results of tests as confirming that a program does what it is supposed to do instead of confirming that it does not do what it is not supposed to do.

   e. He is referring to calling a test case that **did not** find an error "successful" and calling a test case that **did** find an error "unsuccessful".

   f. He is referring to categorizing a test run as **"exhausting"** instead of **"exhaustive"**.

2. (4 pts.) After just 2 days of testing a new product release, John announced to the team that there were approximately 20 "bugs" left in the program. Amazed by this projection, Janice said, "Well, we've already found 30 errors in just 2 days. What makes you think that there are only 20 left?" John replied, "Well, 20 of those 30 errors weren't really "bugs" – they were errors that I seeded into the system before testing started. So, I figure that there should only be about 20 REAL bugs left to find now."

   Assuming John used the error seeding technique discussed in class, how many errors did John "seed" into the system before the team started testing?

3. (12 pts.) For each of "The six essentials of software testing," described by Edward Kit, circle the missing word(s) among the choices provided that he actually used. (Circle ONE only.)

a. Essential 1: **The quality of the _____ determines the success of the test effort.**

i. testers iii. test tools v. test process

ii. test plan iv. test cases vi. test environment

b. Essential 2: **Prevent defect migration by using _____ techniques**.

i. information hiding iii. regression testing v. enhanced interrogation

ii. incremental integration testing iv. effective change control vi. early life-cycle testing

c. Essential 3: **The time for _____ is now.**

i. reviews & inspections iii. formal methods v. software testing tools

ii. continuous process improvement iv. tester training vi. civil discourse

d. Essential 4: **A real person must take responsibility for _____** .

i. test planning iii. maintaining test cases v. the QA function

ii. software quality iv. improving the testing process vi. good snacks

e. Essential 5: **Testing is a professional discipline requiring _____** .

i. trained, skilled people iii. a good sense of humor v. access to drugs

ii. disciplined self-deprivation iv. good intuition vi. adequate compen-sation

f. Essential 6: **Cultivate a positive team attitude of _____** .

i. working together iii. disciplined invincibility v. creative destruction

ii. mutual respect iv. quality improvement vi. cultural relativism

4. (12 pts.) In their chapter, *"Making Meetings Work for Everyone,"* Gause and Weinberg offer several observations and recommendations related to making meetings more productive. For each of the following, circle "is" if the observation or recommendation is included in the chapter, and "is not" otherwise.

a. If the same people are to attend different meetings one right after another, they should take a break between the meetings and change rooms.	is	is not
b. If you don't want to punish people who believe the agenda, you need a way of handling emergency issues that doesn't hurt people who make the effort to attend the meeting.	is	is not
c. One way to see if there is unfinished business at the end of a meeting is to ask each person, "Has every issue on the agenda been resolved as you had hoped it would be?"	is	is not
d. If something comes up that the agreed upon rules do not cover, the facilitator should handle the case fairly and then stop the process to get agreement on amendments to the initial rules.	is	is not
e. Meeting participants should agree in advance that each participant is entitled to a reasonable number of brief, personal time-outs with no explanation required.	is	is not
f. People who are resentful about having to attend meetings may become disruptive to "prove" that they should not have been asked to attend in the first place.	is	is not

5. (4 pts.) Consider the following set of equivalence classes for "identifiers" in connection with a Symbol Table Storage Specification:

Number_of_Characters	***First_Character***	***Other_Characters***
[5, 10] (V)	{ letter } (V)	{ letters or digits } (V)
< 5 (I)	{ $ } (V)	{ other } (I)
> 10 (I)	{ other } (I)	

How many test cases would be required to achieve "***Strong*** *Equivalence Class Testing"* based on this model? How many would be required to achieve "***Weak*** *Equivalence Class Testing"?*

# of test cases required for ***strong*** *equivalence class testing:* _____

# of test cases required for ***weak*** *equivalence class testing:* _____

6. (4 pts.) Consider the following activities normally associated with an inspection process as described by Fagan in his paper, "Design and code inspections to reduce errors in program development."

   a. "C*oaches"* the inspection team, using the strengths of team members to produce a synergistic effect larger than their number.

   b. Schedules suitable meeting places.

   c. Steps the inspection participants through the element being inspected, reading or paraphrasing every piece of logic and taking every branch at least once.

   d. Makes hand-written notes recording errors found during inspection meetings.

   e. Produces a written report of the inspection and its findings within one day of its conclusion.

   f. Resolves/corrects all errors or problems noted in the inspection.

   g. Confirms that all issues, problems, and concerns discovered in the inspection operation have been resolved.

   List **all and only** those activities given above that Fagan explicitly describes as being the **Moderator's personal responsibility**. (If none, write "NONE".)

   Answer: a ,b ,d, g, e,

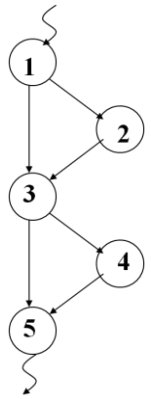
7. (10 pts.) The following statements relate to Grady and Van Slack, et al., "Key Lessons in Achieving Widespread Inspection Use." Indicate whether each is true or false.

a. While HP's culture leads to less formality than in many other companies, the inspection process emphasizes that this must NOT extend to the recording and tracking of meeting results.	true	false
b. A major accomplishment that occurred during HP's "Widespread (Inspection) Belief and Adoption" stage (1989-1993) was the establishment of a single "standard" HP inspection process.	true	false
c. The inspection process step that varies the most at HP is the "cause/prevention" step.	true	false
d. HP created a measure called the Extent-Of-Adoption Metric to gauge company-wide progress in process maturity, depth of use, and breadth of use.	true	false
e. It was found that a particularly strong predictor of successful technology adoption at HP is the number of people trained in that technology.	true	false

8. (10 pts.) The following statements relate to Sauer, et al., "The Effectiveness of Software Development Technical Reviews (SDTRs): A Behaviorally Motivated Program of Research." Indicate whether each is true or false.

a. The authors note that rather than ask whether or not SDTRs find more defects than no review at all, their concern is to ask *how much more effective they are than this most basic requirement.*	true	false
b. The behavioral theory of group performance upon which the authors' results are based stems from studies in which subjects are required to imagine themselves stranded in the desert with a limited number of implements available to them.	true	false
c. The most salient finding of the empirical research on which the theory is based is that group performance is dominated by the available task expertise.	true	false
d. It was found that interacting groups generate a significant volume of new, creative problem solutions beyond those already generated in the individual phase of the task.	true	false
e. The behavioral theory predicts that, where there is no plurality by which to decide whether an issue is a true defect, a group's ability to make a correct discrimination is positively influence by the quality of its group processes.	true	false

9. (8 pts.) Provide a counter-example which proves that Branch Coverage does NOT subsume All-Defs Coverage. (Do not attempt to prove the converse.) Use the program control flow graph below. (Hint: annotate the graph with program statements that define/use variables as you see fit, and describe one or more test cases as needed.) Important: EXPLAIN HOW YOUR COUNTER-EXAMPLE PROVES THIS RESULT.



10. (3 pts.) Which one of the following best reflects the specific purpose of mutation analysis? (Circle ONE only.)

    a. It is used to subvert encapsulation by mutating source code to allow inspection of private variables during white-box testing.

    b. It is used to assess source- or object-code program compatibility with different operating environment versions.

    c. It is used to systematically track state mutations for the purpose of expressing path conditions in useful terms.

    d. It is used to assess the error-revealing capability of a set of test cases.

    e. It is used to estimate the number of errors remaining in a program.

11. (12 pts.) Match each description below to the **SINGLE MOST APPROPRIATE TERM** related to testing object-oriented software among the following. (Note: terms may apply to none, one, or more than one description.)

A. encapsulation	G. polymorphism
B. inheritance	H. observability interfaces
C. unit level O-O testing	K. state machine models
D. object classes	L. methods
E. use/include relations	M. UML sequence or collaboration diagrams
F. higher level O-O testing	N. inspection operations

    ____ Allows variable types and method bindings to change dynamically, thus requiring testers to be aware of the bindings that may occur

    ____ Facilitates the application of partitioning and combinatorial test case design techniques on a state-by-state basis

    ____ Object-oriented design principle that may result in effects of operations being hidden from the tester

    ____ Often focuses on object classes as opposed to individual methods, as testing methods in isolation is not always practical

    ____ Normally begins with the integration of object classes to form inter-object class functional entities

    ____ Abstraction mechanism that leads to issues deciding which methods in a derived class need to be (re-)tested

12. Recall the Cause-Effect models given in the solution notes of Problem Set 1 for the **fmod()** and **sort** functions.

    a. (3 pts.) In non-error cases, the value returned by fmod(x,y) is **x - i*y** for some integer i. Which one of the following best describes the value of "i"? (Circle ONE only.)

        i. The value of i is the value of x/y rounded to the nearest whole number.

        ii. The value of i is either the largest integer not greater than x/y or the smallest integer not less that x/y.

        iii. The value of i is the floating-point remainder of the division of x by y.

        iv. When y is non-zero, i is the largest integer with the same sign as x and magnitude less than the magnitude of y.

12. (cont'd)

b. (3 pts.) Consider each of the following text processing operations:

i. Sorts lines of text files together and writes the result on the standard output

ii. Concatenates already sorted text files and writes the result on the standard output

iii. Merges already sorted text files

iv. Compares two text files line-by-line and writes the differences on the standard output

v. Checks that a text file is ordered as specified by the arguments and the collating sequence of the current locale

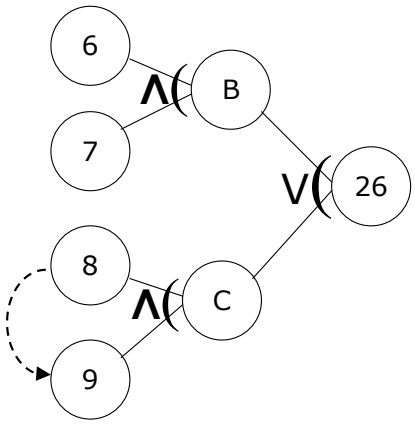
List **all and only** those operations listed above that are directly supported by the sort function: (If none, write "NONE".)

Answer: _____

c. (10 pts.) The following statements relate to differences in the way program behaviors are modeled in the fmod() and sort Cause-Effect models, and in how the models are used to generate test case templates. Indicate whether each is true or false.

i. "Culling rules" are employed with the sort model to generate test case templates due to the large number of Cause combinations resulting in each Effect; they are not employed, however, with the simpler fmod() model.	true	false
ii. Working with the fmod() model to identify test case templates is simpler than with the sort model when "determining the truth value of all other Effects."	true	false
iii. The sort model is more complete than the fmod() model in the sense that all combinations of individual output conditions/behaviors are explicitly represented in the model.	true	false
iv. Identifying test cases to cover All Feasible combinations of **EFFECT** Values (AFC**E**V) using the sort Cause-Effect model would be easier than doing so using the fmod() Cause-Effect model.	true	false
v. In order to reduce model complexity, the values returned by matherr (via errno) were not coupled with the behavior of sort in specifying Effects.	true	false

13. (18 pts.) Consider the following Cause-Effect graph.



a. How many test cases would be required to achieve **AFCCV** (All Feasible Combinations of Cause Values) coverage?

b. Enter appropriate values in the Cause-Effect Analysis test case coverage matrix below for each **feasible combination of connected Cause values that results in Effect 26 being true**.

	TEST CASE TEMPLATES													
CAUSES	1	2	3	4	5	6	7	8	9	10	11	12	13	14
(6)														
(7)														
(8)														
(9)														
EFFECT														
(26)														

c. Which, if any, of the test cases shown in your coverage matrix above would be **eliminated** by application of the Culling Rules discussed in class? (List the column numbers, if any, of those that would be eliminated.)

Test cases that would be eliminated by Culling Rules: _____

14. (12 pts.) Match each description below to the **SINGLE MOST APPROPRIATE TERM** among the following. (Note: terms may apply to none, one, or more than one description.)

A. Fault-based test
B. Installability test
C. Thread test
D. Alpha test
E. Performance test
F. Stress test
G. "Lights out" test
H. Regression test
I. Reliability test
J. Unit test
K. Benchmarking
L. "Soak" test
M. Recovery test
N. Usability test
O. Serviceability test
P. Beta test
R. Security test
S. "Smoke" test
T. Exhaustive test
U. Compatibility/conversion test
W. Causal analysis
X. Test-driven development

___ Appropriate interpretations for "failure" and "time" are critical Reliability test

___ Testing of the smallest programmer work assignments that can reasonablybe planned and tracked UNIT TEST

___ Automated, stand-alone testing not requiring human involvement Lights out test

___ Testing a system version over a significant period of time to discover latent errors or performance problems soak test

___ Introduced in support of agile methods; code is developed incrementally, along with one or more tests for each increment test driven devlpment

___ May be automated by combining a keystroke recorder and playback tool with a data/output comparator regression

___ When all combinations of all possible input and state variable values are covered exhaustive test

___ Process aimed at identifying the origin of errors and approaches to eliminate future occurrences casual analysis

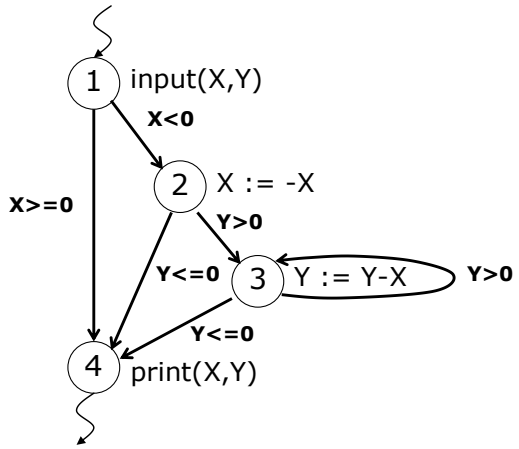
___ Application-specific metrics related to *understandability, learnability,* and *operability* may be employed. usability test

___ Coverage includes product media correctness and fidelity, plus relevant documentation (including examples) installability

___ Focus is on capabilities such as detecting exceptional conditions, switching over to standby systems, and maintaining audit trails recovery

___ Typical coverage includes post-delivery change procedures (adaptive, perfective, and corrective scenarios), supporting documentation, and system diagnostic tools serviciability

15. (25 pts.) Consider the program control flow graph below.



a. Identify ALL du-pairs for variable X.

b. Identify ALL du-pairs for variable Y.

c. Identify all feasible du-paths associated with du-pair (2,4) for variable X.

d. What is the total number of test cases, at the minimum, that would be required to achieve each of the following for this program? (Circle one only for each.)

i. *All-Defs coverage:*	(1)	2	3	4	8	16	infinite
ii. *All-Uses coverage:*	1	2	(3)	4	8	16	infinite
iii. *All-DU-Paths coverage:*	1	2	3	(4)	8	16	infinite

e. Give the complete, non-simplified path condition for path <1,2,3,3,3,4> in terms of the input values of X and Y. (Do not combine or simplify predicates.)

f. Give an example of initial values for X and Y, if any, that would satisfy the path condition for the path given in part (e). If none, write "none".

On my honor, I have neither given nor received unauthorized aid on this exam and I pledge not to divulge information regarding its contents to those who have not yet taken it.

_____

SIGNATURE